Many Streams to Cross

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Forest roads, unless in a very poor condition, are seldom given a second thought by most travelers. They are considered simply a route from point A to point B for vehicular travel. But for the landowner or manager, roads are a topic of great concern. They are critical assets for use of the land by providing day-to-day access and an avenue for the number one revenue-producing management technique, the harvest of timber. They also have the potential to cause enormous problems, including both economic and environmental concerns.

The cause of the majority of problems with forest roads can be traced to water, either as moisture soaking into the driving surface of a roadbed or as surface flow causing erosion. Therefore special attention must be given to points where the road is in constant or frequent contact with water, such as stream crossings. The three most common types of stream crossings used are culverts, fords, and bridges. Each has unique properties that are best utilized based on watershed characteristics and expected traffic requirements for the road.

Culverts are the most common type and are best suited to smaller watersheds or crossings that expect high volumes of traffic throughout the year. As the size of the watershed increases, culverts become economically limiting due to the expense of larger pipes and the amount of fill material required to build the road elevation above them. Fords of various types are typically more expensive than culverts but can be economically used on larger watersheds if certain conditions exist. A stream channel bottom with a lot of rock is ideal if the channel banks are not so high as to require steep approaches. Fords can also be installed in soft channel bottoms but require more excavation and additional rock to strengthen the crossing and stabilize the approaches. Bridges are the most expensive alternative, and are used on crossings over large watersheds and in conjunction with extensive traffic requirements.

Evaluating the crossing

Many stream channels, even those with large drainage areas, can be misleading by the small volume or absence of water flowing in them most of the time. This causes many road builders to install a crossing type that is not suitable to protect the road during flood stage conditions. This is particularly true in south Alabama where larger watersheds combined with flatter topography contribute to many of the failures. Before installation of any type of stream crossing, some preliminary work should be done to determine which method would be the most effective for that particular site. Your local extension agent should be able to get you started. It is here that a little time and effort up front can go a long way towards protecting your investment.

For an engineer designing a stream crossing, several pieces of information must be brought together into the final recommendation. The expected design life, traffic requirements, statistical rainfall data for that region, and watershed characteristics all play a part in the analysis. The size of the watershed is the first piece of information that must be pinpointed. Finding the point where the road crosses the stream on a topographic map, and then delineating the area that drains runoff to that point can do this. An average slope and maximum flow distance from the farthest point of the watershed can also be found from the topographic map. The types and percentages of ground cover must also be evaluated for use in calculating a design discharge for the crossing.

Historical rainfall data for the region and statistics play an important role in determining the amount of water flow that a stream crossing is designed to handle. Designers use the term *return period* for storm event calculations. If a pipe is sized for a ten-year return period storm event, then statistically it will overflow once every ten years, or in other words there is a 10% chance it will overflow in any given year. For smaller watersheds where culverts are most frequently used,

Installing water bars and/or turnouts prevent road erosion on harvested site.

Installing a pipe at the correct elevation and slope, and using good fill material contributes to long-term cost effectiveness.

the calculations are fairly straightforward since we assume that rain will begin and end at all points simultaneously. A peak discharge is calculated for a given return period storm event and the pipe is sized to carry this flow in the configuration and length dictated by the road. For larger watersheds this becomes more complicated as other factors enter into the design. For example, a balance must be found between storage capacity upstream of the crossing and amount of roadfill required to achieve it. In some cases it may be more economical to size the pipe to carry a portion of the design discharge, then construct a stabilized overflow point for the roadbed similar to an emergency spillway on a pond dam.

Installation

After the analysis has been completed and the type and size of the crossing has been determined, a proper installation must be executed to get the most out of the money spent. The first step is to find a reputable contractor who has experience in this area. He should also have the proper tools and equipment, such as a contractor's level, and be diligent in using them. This is especially true on stream crossings where locating the pipe/ford elevation and slope is critical to its survival. A crossing installed too low will fill in with sediment over time and decrease the maximum flow it can carry. One installed too high will back up water on the upstream side and cause potential for washing on the outlet.

An experienced contractor will also know if the local fill material that is readily available is suitable for the roadbed. In many cases the excavated material near the stream channel is not usable, and better fill must be obtained, usually from a nearby hillside.

Once the pipe is positioned and good fill material has been obtained, care must be taken that the pipe is not damaged or does not shift when covering it. It is also a good idea to manually compact the fill under the edges of the pipe in small lifts to ensure that no voids exist around the outside of the pipe.

Top left: *Insufficient fill material over the top of the pipe contributed to this failure.* **Top right***: This example of good vegetative cover will protect the side slopes of the road and decrease the amount of sediment reaching the stream.* **Bottom left:** *A geo-web ford, when properly installed can be a good alternative to a culvert in the right situation.* **Bottom right:** *Low-water bridge at flood stage.*

Protection

It is also at the creek crossing that the most potential for environmental concerns exist. Many roads, such as those that are entrenched, provide a direct path for runoff to be carried to the creek. This means that soil particles that are washed off the exposed areas of the roadbed can be deposited directly into the channel causing sedimentation and turbidity in the stream. It is always a good idea to have waterbars and/or turnouts constructed at points along the road approaching the crossing to divert runoff out of the roadbed and ditches. This will eliminate a direct path for runoff to follow to the stream and give the adjacent groundcover the opportunity to filter out sediment.

Vegetative cover is also a low-cost, long-term deterrent to erosion and sediment transport. Some type of permanent grass cover should be planted on sideslopes and ditches, and should be mixed with an annual, quick germinating seed such as browntop millett in spring and small grain in fall.

The problems with stream crossings are variable and potentially expensive to control. But with proper assessment and implementation of good road-building techniques, a viable solution can be found that minimizes the long-term costs of the crossing and maximizes its useful life.

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